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Publication date:
2006

CentER

Discussion Paper

No. 2006–59

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June 2006

ISSN 0924-7815

Tilburg University

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ABSTRACT
Successful supply chain collaboration (SCC) practices are rather exceptional, yet collaboration is believed to be the single most pressing need in supply chain management. In this paper we discuss the realities of SCC, present prerequisites for the collaboration process, indicate where the process starts and where it may terminate. During the discussion we make use of the concepts of Theory of Constraints (TOC) and approach SCC as an ongoing effort dealing with the supply chain constraints.
The roles of the entities in this ongoing effort are not always clear. Often SCC is proclaimed to be a joint decision-making process. However, keeping in mind the powerhouses in the chain, we believe that other structures are possible as well.
We emphasize the need for: 1) having an adequate supply chain strategy and well-articulated goals, which form the basis for: 2) leading supply chain change, and: 3) governing the continual process of strategy alignment and supply chain change, which is itself a dynamic process. These three tasks are featured by many interactions and characterize the continuous improvement of a SCC process. A step-by-step approach like this enables the involved chain entities to climb the ladder of collaboration and take the supply chain performance to a higher level.

Keywords: supply chain collaboration, theory of constraints, dynamic alignment, business roles, change strategies

JEL code: M00

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1. INTRODUCTION

Supply chain management (SCM) evolved from a traditional focus on purchasing and logistics practiced between 60's and mid 90's, to a broader, more integrated emphasis on value creation in the new millennium. Leading companies increasingly view supply chain excellence as more than just a source of cost reduction- rather, they see it as a source of competitive advantage, with the potential to drive performance improvement in customer service, profit generation, asset utilization, and cost reduction. Effective collaboration within each entity (cross-functional) and between chain entities (cross-enterprise) is essential to achieve these goals, individually and collectively.

The literature on supply chain collaboration (SCC) is very extensive in both business and academia, but not always on target. For example, few writers focus on the cultural aspects of collaboration, which is a serious oversight. A recent survey conducted by Supply Chain Management Review and CSC (2004) observes that collaboration is cited as the single most pressing need; but how to achieve it is not well understood. The survey showed that 44% of the organizations have functions specifically for supplier and customer collaboration. However, only about 35% of the collaboration initiatives turned out to be even moderately successful. And when the respondents were asked to respond to the statement whether their supply chain is vulnerable due to uncertainties associated with implementing new supply chain improvement programs, less than 20% disagreed. Investing in an integrated supply chain through collaboration is found to be risky. Initiatives failed or appeared less promising than expected. Why is that? Perhaps the answer is that not all participants in every supply chain have embedded collaborative values. You can't collaborate with a party that lacks a genuine desire to collaborate.

Indeed, our field collective experiences and the literature surveys on SCC suggest that true collaboration is far more difficult to achieve than simply talking about it as many companies do. The reasons for this include:

- Time span – While everybody speaks of network integration, most companies have difficulty aligning their internal processes and business units with customers and suppliers. Relationship building takes more time than writing an article or a business prospectus.
- IT infrastructure – Lack of connectivity, a common platform for data communication and information exchange.
- Trust – The unwillingness to share core information due to confidentiality or lack of trust; this is a cultural factor, one of many in play.
- Organization design – The 'Functional' structures are often overpower the 'Account Management' structures designed to foster collaboration between parties.
- Competition – Management fears that integration might limit quick response to major changes in the competitive environment or are anxious that current suppliers may become a future competitor, or that a customer will backward integrate into their domain (Fawcett and Magnan, 2002).
- Fear of external pressure – Smaller, resource-constrained companies fear that the larger channel "partners" would use SCM opportunistically to extract value and squeeze margins (Fawcett and Magnan, 2002).
- Powerhouses within the organization – Different departments are eager to maintain their bargaining power, and friction typically arises between procurement and sales, marketing and manufacturing, etc.
- Financial – Short-term thinking dominates current business, making longer-term agreements very difficult. Financial and operational agreements on inventory ownership, sharing investment

costs, pooling resources, and sharing savings, and sharing forward business plans are indispensable to success in SCC practices.
- Other cited reasons are: conflicting business cultures, conflicting goals and values, etc.

The goal of this paper is to discuss the realities of supply chain collaboration. The first common erroneous assumption of SCC is that the involved companies must collaborate on basis of equal power. Surely, the powerhouses in a chain play an important role in the collaboration process and significantly influence the rate of success, yet their roles must be recognized. A second mistake is that people tend to misjudge the level of collaboration required. Full integration is certainly not necessary for every industry or supply chain. A third mistake is that we are expending too much effort in the wrong places by assuming that all supply chains have the potential to be 'collaborative'? Not all supply chains are likely to be suitable for collaboration. This relates closely to the fourth mistake, which is a wrong assessment of priorities, for example: investments in wrong areas usually mean sacrificing global chain effectiveness for local efficiency priorities, and may quickly lead to the end of a SCC initiative.

While these realities provide insights in why collaboration efforts can be unsuccessful, we would also like to provide more positive news on SCC. As collaboration initiatives are approached as an ongoing process, similar to the Theory Of Constraints (TOC) concepts, we derive three key on-going cycles in properly managing SCC: 1) the strategy cycle: identification of the right supply chain strategy which needs to be tailored to each entity; 2) the change cycle: what are the priorities and global versus local contradictions; and 3) the control cycle: managing 'alignment' and corresponding supply chain change as a dynamic on-going process.

Overall, we are trying to help executives develop strategies that deliver high performance by building and sustaining relationships that are interdependent in and along supply chains.

The remainder of the paper is organized as follows. Section 2 briefly discusses the literature on supply chain collaboration. Section 3 discusses the realities of supply chain collaboration. Section 4 elaborates on the need to approach collaboration as an ongoing process. Taken to an extreme, 'collaboration' can become a distinctive competence in a particular organization. We will talk about the cycles of collaboration concerning supply chain strategy, supply chain change, and supply chain control. Finally, Section 5 presents the conclusions.

2. LITERATURE

Collaboration is increasingly promoted as somewhat of a 'Silver Bullet' in many areas of supply chain management (SCM). By the term SCM we refer to the integration of all activities associated with the flow and transformation of goods, information, and the associated funds, through improved supply chain relationships of all involved entities. The following articles are recommended for details on SCM definitions (Mentzer et al., 2001), SCM processes (Croxton et al., 2001), SCM modeling and decision-making (Narahari and Biswas, 2000), and an extensive framework of SCM research (Chen and Paulraj, 2004).

The key to improved relationships and start down a collaboration path is to address the ways that entities in supply chains work together. Collaboration proves to be important since, as Cooper et al. (1997a) formulate, sub-optimization occurs when each organization in the supply chain attempts to optimize its own results rather than integrate its goals and activities with other organizations to optimize the results of the whole chain. Successfully formulating the appropriate strategy in a

particular customer/supplier situation implies that all entities in the chain must work together. This brings us to another important aspect, understanding what are the most appropriate strategies to pursue. Since an entity is almost certainly engaged in more than a single supply chain (Gattorna, 2006), this can be a complex issue, involving the design of a collaborative chain, where *financially independent* entities try to get the *dependent* parts of the chain to "*play*" together, i.e. ensuring that the entities in a chain interact successfully to provide the necessary coordinated outputs.

In our research we focus only on relationships that are involved in supply chain collaboration (see Figure 1). Arm's length relations are purely transactional and do not have any degree of collaboration. Arm's length implies a zero-sum case: if one wins, the other loses. Supply chain collaboration is neither the same as joint ventures or strategic alliances, which normally entail some degree of shared ownership across the parties (Lambert et al., 1996). Nor is it the same as vertical integration, whereby there is common ownership of many supply chain members (Cooper et al., 1997b). In addition to Lambert (1996), we view partnerships as a special case of supply chain collaboration while other partnerships may involve extended financial linkages that are not necessary in supply chain collaboration.

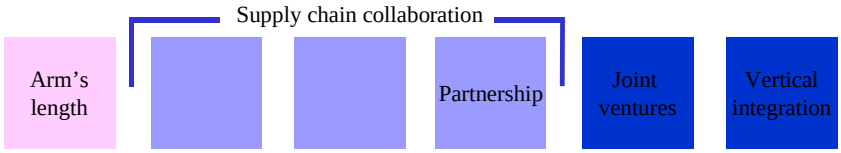


Figure 1 - the types of relationships (modified from Lambert et al., 1996)

There are many ways to be engaged in supply chain collaboration. Cooper et al. (1997b) elaborate on these different approaches of collaborating in the supply chain (see Figure 2). The first is the dyadic approach, which may exist at numerous levels in the chain. "Many organizations will focus in their early attempts on the channel members with whom they have immediate contact." The second approach uses a channel integrator. "This channel leader plays the key role in setting the overall strategy for the channel and in getting the channel members involved in and committed to the strategy." The third approach uses a fourth party logistics (4PL) entity as a centralized 'optimization tool' to coordinate and control the channel. As suggested the fourth approach, vertical integration, adopts ownership of other channel members and therefore is not considered as collaboration.

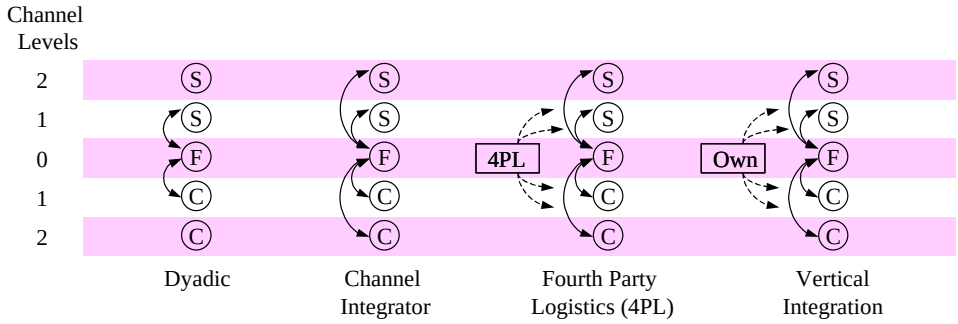


Figure 2 - multiple ways of supply chain collaboration (modified from Cooper et al., 1997b)

In addition to different approaches of collaboration the depth of the relationship can vary. This is what we call the level of collaboration or intensity. Lejeune and Yakova (2005) give an extensive outline of the levels of collaboration. The authors make a link to Fiske's theory of relational models, which is known as "the basic-level grammar of sociology". The authors conclude that 'true goal congruence' is only achieved in the case of communal sharing, i.e. where people treat some dyad or group as equivalent and undifferentiated. A seemingly statement but difficult to realize in practice.

3. REALITIES OF SUPPLY CHAIN COLLABORATION

Paradoxically, supply chain collaboration is immense popular both in business and academia and at the same time most collaborative initiatives end up in failure (SCMR and CSS, 2004; Bittici et al., 2005; Fawcett and Magnan, 2002). We should therefore face up to the realities of supply chain collaboration. The following questions attempt to find the problems at source:

1. "Equality between partners?"
Collaboration is not always purely voluntary. Powerhouses in the chain, such as Wal-Mart, have a major impact on how collaboration is practiced. Some supply chain entities may be forced to participate; others are not fully supportive of collaborative ideas, or desire more influence in the collaboration process. There appears to be a spectrum of collaborative relationships between forced participation and equal matching. Ideally the relationship should be based on equal matching. But how often is this the case? We will elaborate further on the various business roles within the supply chain collaboration.

2. "Ongoing or limited?"
Supply chain collaboration can be seen as an ongoing effort of dealing with supply chain constraints. Every time a supply chain constraint is removed, the supply chain entities accomplish a higher level of supply chain performance. These concepts of dealing with constraints are known as Theory of Constrains (TOC) (Goldratt, 1990) and originate from a manufacturing environment. Yet, at some point a constraint may be encountered that limits the collaborative efforts to move on. We will argue that the structure of the collaboration group greatly impacts which constraints are likely to be elevated and which not, hence limiting the achievable level of supply chain performance.

3. Potentially collaborative?
Maybe we are expending too much effort in the wrong places by assuming that all supply chains have the potential to be 'collaborative'? Certain supply chain may not be suitable for collaborative relationships at all. Similarly, the level of suitability for collaboration differs amongst the supply chain channels. Supply chain strategies and operations should be anchored around an in-depth understanding of 'buyer behavior' (Gattorna, 2006). For any given product or service category, there will be no more than 3-4 *dominant buying behaviors* evident in the customer base, which in turn means a corresponding number of unique supply chain configurations to 'align'.

4. "Balancing priorities?"
According TOC concepts, there are only few constraints are present in a system at a time. TOC warns against traditional cost accounting methods that view operating expenses as the dominant measurement. Since operating expenses are found everywhere, almost everything is considered as important. As a result, global chain effectiveness is often overruled by local efficiency goals. We believe that expensive SCC programs should be preceded by a thorough supply chain analysis that

properly balances global versus local priorities. The main question should be "where and what actions are required, first?"

3.1 COLLABORATION: EQUALITY BETWEEN PARTNERS?

The SCC principle tries to build a strong unity while keeping the original ownership structures intact. Although we do not consider cases where other supply chain functions are brusquely purchased, we are not naïve enough to believe that power does not play a role in collaboration. It may occur that supply chain entities are forced to collaborate, desire for more participation in the decision-making, or disagree on certain issues, and ultimately find they are not in a position to lead any change.

Mentzer et al. (2001) indicate that forced participation encourages exit behavior if the opportunity exists. Also Maloni and Benton (2000) warn that power-holders in the supply chain should be careful applying their power; misuse will lead to dissention and underperformance. In their empirical study they show that there are different sources of power with contrasting effects on supply chain performance.

Examples of asymmetric power in supply chain collaboration are found in aerospace industry (Leslie and Young, 2005), the food industry (Van Dijk et al., 2003), and the automotive industry (Dyer and Nobeoka, 2000; Maloni and Benton, 2000).

We believe that comprehending the position of power, and the division of roles, are the basis for defining the collaboration process and determining the most appropriate future measures. We consider three main roles: *collaboration leader*, *collaboration coordinator*, and *remaining collaboration members*. In Section 3.2 we elaborate on possible combinations of these roles, indicating a variety of collaborative structures.

The *collaboration leader* is the initiator of the collaborative effort. Perhaps this entity is not the first entity that comes up with the collaboration ideas or prepares the collaboration prospectus but for sure it gives the "go" or "no-go" signal. Without the approval of the collaboration leader there is no collaboration. The leader's role is to perform a broad range of activities, ranging from evaluating the main strategic partners, shaping and communicating the vision and supply chain strategy, coordinating collaboration meetings, linking the relationships, monitoring overall performance, and providing incentive structures to improve performance. In most supply chains there will be only one such entity but there can be multiple leaders in a chain.

The *collaboration coordinator* is the entity that is chosen to coordinate collaboration activities. While the collaboration leader focuses obviously more on leadership than management, the opposite is true for the collaboration coordinator. The task for this entity is mainly management of supply chain transformation. Three scenarios are possible: the collaboration leader chooses to coordinate the collaboration itself or it appoints another entity to be the coordinator, a supply chain member or a non-member (4PL) is chosen. This decision depends mainly on the level of "threats" faced by the collaboration leader if the coordination is performed outside this entity, for example a loss of bargaining power.

Remaining collaboration members are entities that are involved in the collaboration process but do not have the leading or coordinating role. Collaboration might be imposed to these entities: they are given the choice to cooperate or to leave. This collaboration can be still an excellent way to ensure continuity and enhanced profitability if the process is carried out properly, considering the prerequisites explained in Section 4.

3.2 COLLABORATION: ONGOING OR LIMITED?

SCC can be seen as a sequence of business initiatives carried out by the collaborating members of like mind. Whether this sequence is ongoing or limited is the question. An ongoing collaboration requires: a) a generative dialogue among entities to ensure strategy alignment; b) individual entities with group concerns to guarantee balanced priorities; c) a creative and innovative chain to avoid merely the fulfillment of the set of business initiatives; otherwise the collaboration will be limited. Applying TOC concepts helps us realize that SCC is an ongoing process, yet sometimes it may reach its limit.

The TOC concepts (Goldratt,1990) were originally adapted to a manufacturing environment, however they apply to the supply chain very well. As in any system, the supply chain is haunted by constraints, which we refer to as supply chain constraints. The purpose of SCC is to deal with these supply chain constraints and bring the supply chain performance to a higher level. TOC introduced a five-step approach to deal with the system's constraints (which will be discussed in more detail in Section 4). The fifth step of this approach is return to step one, because whenever a constraint is lifted, a new constraint will appear somewhere else in the system. And all steps should be executed again. As such, TOC supports the continuous improvement philosophy, and implies SCC is an ongoing process.

Three types of constraints can be encountered: physical constraints, market constraints, and policy constraints. *Physical constraints* are tangible, like resource capacities, people or machines. Hence, physical constraints are also known as capacity constraints or resource constraints. Elevating a physical constraint practically comes down to adding capacity, either by buying additional capacity or by outsourcing production or services. *Market constraints* are easier to identify but difficult to lift. Obviously, a market constraint implies the size and complexity of the market, i.e. demand is lower than available capacities. Elevating a market constraint affects other departments as well, like marketing, product development, etc. *Policy constraints* are intangible and therefore difficult to identify for the management. Policies are rules to coordinate and control the systems. Incorrect policies may arise in situations where the business environment has been changed but the old policies remain. Moreover, incorrect policies can be local, performing well, but have negative impacts on the system as a whole. Elevating a policy constraint comes down to removing the old rules and introducing new ones that are consistent with the chain strategy. Changing policies and the cultural mindset of employees are tough and may take a long time.

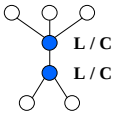
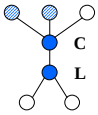
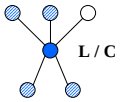
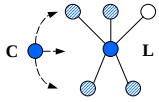
As stated earlier many collaboration practices fail, suggesting that SCC is limited. Constraints may be encountered that could not be dealt with or the collaboration leader did not see the benefits for further collaboration. We identify the following situations in which a constraint is blocking SCC:

- Resource constraint - Adding capacity should normally not be a problem, unless the investment benefits are not justifiable. This is more likely to happen when the financial linkages (cost/profit sharing) with the collaboration members are missing.
  Another resource constraint can be raw materials. Eventually, shortage of raw materials might limit the collaborative supply chain to increase throughput. Structural shortages can lead on the other hand to tighter horizontal relationships.
- Market constraint - the size of the market cannot be increased. SCC needs to be expanded to other departments within the supply chain entities that were not involved in the first place.

- Policy constraint (1) -When the policy constraint lies within the leader entity, the leader might not want to acknowledge that and be willing to change. While policy constraints at other entities would hardly cause the collaboration process to end.
- Policy constraint (2) - The type or nature of the market does not obviously argue for collaboration. For instance in the dynamic flower market buyers continuously browse wholesalers for the cheapest price. Collaboration between wholesaler and customer would imply a drastic deviation from the old trade system and in fact comes down to serving a complete other market segment. Next section "Are all supply chains collaborative?" will elaborate on this issue.

The diagrams shown in Table 1 represent some general collaborative structures regarding the three main roles listed earlier. These diagrams offer graphic scope for variations on the shape of the evolving chain (indicated by the circles), the position of the leader (colored circle, denoted by L), coordinator (gray circle, denoted by C) and remaining collaborating members (hatched circles). Note that the empty circles represent entities that are not included in the collaboration.

Table 1 - Collaboration practices and their limits

Collaboration Business Model	Situation	Collaboration Limits		
		Physical Constraint	Market Constraint	Policy Constraint
	Dyadic relationship between two equally powered entities. E.g. Major Manufacturer, Major Retailer	Least Likely	More Likely	Less Likely
	Collaboration leader sets rules, but lets other entity coordinate. E.g. Major Wholesaler, Major Retailer	Least Likely	Most Likely	More Likely
	Collaboration leader also takes control. E.g. Major OEM	More Likely	More Likely	Most Likely
	Collaboration leader sets rules and outsources coordination to 4PL.	Less Likely	Most Likely	More Likely

3.3 COLLABORATION: POTENTIALLY COLLABORATIVE?

Structure affects behavior and vice versa behavior affects structure. This phenomenon is also established by the well-known beer-game. Yet, we are interested which structures, i.e. supply chains, are especially attractive to collaboration and which supply chains do *not* have collaborative value? In the previous section we discussed constraints blocking collaborative initiatives. Here, we will show that the supply chain structure itself can be a constraint. In addition, we like to distinguish between different customer and supplier types, hence distinguish between supply chain channels. Some channels may have collaborative value while others have none.

Constraints blocking the supply chain appear in different shapes. We discussed how resource, policy and market constraints could limit the collaborative initiatives. Sometimes it is even not

interesting to collaborate at all. Some people typify such situations as a consequence of policy constraints. However, it is not just that. The entitle *supply chain structure constraint* is better. Although policies are part of the structure, they are a result of the structure as well.

Our experience with the Dutch flower export industry is a good example of such *supply chain structure constraint* blocking any collaboration. At the traditional large flower exporter the notion of business dynamics is profoundly presented throughout the business operations. Each of these companies is located right next to the auction building, their main supply source. There is intensive cooperation between the sales and purchase units. And internal logistics is completely designed to provide quick response. The statistics show that more 70% of daily total sales are so-called last-minute sales. These last-minute customers are upon the very last moment of purchase browsing for the best deal. Although collaboration is possible with this group of highly dynamic buyers, it would drastically alter the business structure. Therefore, we suggest given this structure, the collaborative value is relatively small.

For any given product or service category, Gattorna (2006) explains, there will be no more than 3-4 dominant buying behaviors. In-depth knowledge of the customer base allows recognizing the different needs for each relationship type. Implying that each relationship type, roughly addressed as supply chain channel, has a different need for collaboration, in terms of scope and intensity.

Some retailers has worked out how to play the game very well with their supply base, and collaborate with key suppliers while acting in a very adversarial way with the bulk of their suppliers, playing one off against the other for price.

Interestingly those companies that do not recognize which of their customer base desires a genuine collaborative relationship, very often end up losing these very profitable customers as they seek to satisfy the more demanding segments in their marketplace, generally at a higher cost-to-serve.

Clearly, being aware of the customer and supplier base is highly important. Not all customers or suppliers ought to be treated equally. Not all of them will have collaborative values. In some cases the collaborative value is only found in relatively small part of the business, then collaboration may not prove to be beneficial at all.

3.4 COLLABORATION: BALANCING PRIORITIES?

The business community understands the key principle that their organization would perform better if all parties would follow the same goal and optimize the results of the chain. Similarly Fawcett and Magnan (2002) conclude: “Managers are convinced that future success, i.e. long-term competitiveness, depends increasingly on synergies created through collaborative relationships.” We believe difficulties lie with: a) identification of the weak spots in current supply chain and: b) finding the balance between global chain effectiveness versus local efficiencies.

Cutting costs locally always looks tempting, but TOC warns that against traditional cost accounting approaches that view operating expenses as the dominant measurement. This gives the impression that an organization and the supply chain are composed of independent variables. Since operating expenses are found everywhere, almost everything is considered as important. TOC suggests the opposite: only a few issues deserve top priority in bringing chain performance to a higher sustainable level. The key to accomplishing the collaborative chain is to take a strategic perspective across the entire chain rather than focus on individual entity level. This is supported by further evidence that we are moving from a world where individual entities stand and compete

alone in their respective markets, to a world where supply chains will be competing against other supply chains. The global airline industry and the automotive industry are prime examples of this phenomenon. A balance between chain requirements and individual players has to be sought and found. But finding this kind of compromise can be risky, and works best where there is a good cultural 'fit' between the parties involved. Collaboration initiatives can be endangered when local priorities of individual entities and global priorities of the supply chain get confused. Various supply entities may feel uncomfortable with the changes, and may even misuse their power in order to preserve old ways. Protests are executed by communicating wrong data, purposely delaying transactions, etcetera. Obviously this negative behavior should be avoided at any times.

Better invest the right way from the outset. Investing in the wrong place or compromising on local and global priorities may have worse results than just lower expected returns. The ongoing collaboration efforts form a reinforcing process. An incorrect start leads to poor results, which in turn impacts future collaborative efforts negatively. Supply chain relationships often get caught up in a virtuous cycle (Akkermans et al., 2004). If some strong positive pulse does not break this virtuous cycle, the collaboration initiative could come to a quick end. This observation is supported by the recent survey conducted by SCMR and CSC (2004). A vast majority of the respondents commented that the supply chain is vulnerable due to the uncertainties associated with the implementation of new supply chain collaboration initiatives. Therefore, balancing global and local priorities is an essential step in the collaboration process.

4. LOOPS OF SUPPLY CHAIN COLLABORATION

Clearly the gap between number of started SCC initiatives and the number of successful ones is unnecessarily large. Keeping the realities in mind, we will now elaborate on the prerequisites of the SCC process. As we have argued the SCC is essentially an ongoing relationship-focused process. Hence it makes sense to present SCC decision-making as loops, which are characterized by interaction and continuance (see Figure 3). We divide the SCC decisions into three parts, which are briefly described below.

1. "The strategy loop"
No successful transformational change occurs without proper leadership. "Or they must have been very lucky", Kotter (1996) explains. The collaboration leader and a selected group of strategic partners take the lead. This group is responsible for both creating a sense of urgency, making the involved supply chain entities believe in the collaboration and its changes, *and* for developing the vision and appropriate supply chain strategy. The latter should not be a blanket approach for the whole chain, but needs to be tailored down to each entity and supplier-customer combination.

2. "The change loop"
If the strategic objectives have been clarified, the priorities can be analyzed. What to change and what to change to? We do not want to waste money by making wasteful investments. Quantitative analysis should provide additional evidence of the benefits of the suggested collaboration initiatives and provide the details on supply chain execution. With help of the TOC concepts we can identify and deal with the (few) supply chain constraints that are currently blocking performance. Again the implications for each entity will differ and depend on its position and role in the supply chain.

3. "The control loop"
Governance of the supply chain collaboration is needed to constantly check whether the changes are executed correctly, whether the priorities are still the same, and whether there are signs to change the strategy. In other words, control is needed to govern the course of the supply chain with respect to the business dynamics, and control governs the execution of the changes. In fact the control loop plays an important role in keeping the collaboration an ongoing process. It is about being alert.

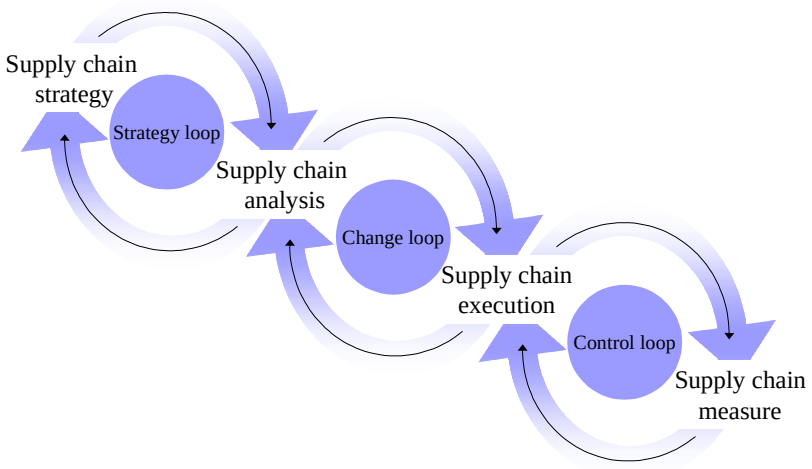


Figure 3 - The loops of supply chain collaboration

These loops will be discussed into more detail in Sections 4.1 - 4.3. Finally, in Section 4.4 a general growth path is presented. As the loops of collaboration are revisited again and again, the supply chain is step-by-step brought to a higher performance through superior alignment between the participating parties. Hence, the growth path is also called the "ladder of collaboration".

4.1 THE STRATEGY LOOP

Kotter (1996) describes how change begins at the top and with three discrete actions by the leaders: (1) create the guiding coalition; (2) establish a sense of urgency; and (3) develop a vision and a strategy. Kotter's analysis concentrates on organizational change showing similarities to supply chain change through collaboration. In this section we discuss the evaluation of strategic partners, alignment of the corporate strategy with supply chain strategy, and the identification of the most appropriate supply chain strategy.

Choosing the strategic partners
The first action Kotter mentions is to create the guiding coalition, which comes down to the choice of the strategic partners. Often strategic partners are loosely referred to as most important suppliers or most important customers. We define a strategic partner as an entity that should be included in the development of the supply chain strategy and objectives that will be employed in the future collaboration. Either its absence could seriously damage the collaboration or its presence provides valuable inputs to the collaboration plans. All other participating entities are part of the transformational change but do not have an active role in the strategic consideration (see Section 4.2).

Some strategic partners possess a special function, namely the collaboration leader and coordination coordinator. Recall that the collaboration leader may not be the first entity that comes up with the collaboration ideas or prepares the collaboration prospectus but for sure it gives the “go” or “no-go” signal. The collaboration leader will consider the roles of its strategic supply chain partners in a twofold decision: a) does the leadership task need to be shared, and: b) which chain entity will be the collaboration coordinator?

The first decision, whether collaboration leadership needs to be shared, is more or less an issue of supply chain power. If the collaboration leader is accompanied with an equally powerful supply chain member, shared leadership or joint leadership is the only solution.

The second decision, concerning the choice of the collaboration coordinator, would logically apply to the entity with most knowledge and experience. Yet, business is not all that logical and also here the powerhouses play an important role. In general, one could say that if there are two equally powerful entities, i.e. two leaders, joint coordination is most likely. This often, but not always, occurs in so-called Collaborative Planning Forecasting and Replenishment (CPFR) initiatives. In case of having two (or more) collaboration leaders, 4PL coordination is also a possibility; especially if the leader is involved in multiple SCC initiatives. If there is only one collaboration leader, coordination can be undertaken by the leader itself, another supply chain entity or a non-supply chain member, i.e. 4PL. When it concerns a complex product, made of many components coming from many independent supply sources, the leader will more likely choose to take charge of the coordinating tasks or outsource coordination to a non-chain member, i.e. again a 4PL.

Aligning supply chain strategy and corporate strategy

The second action Kotter mentions is to establish a sense of urgency. It is the responsibility of the strategic partners to agree on the strategy and ultimately convince the other supply chain entities to support the transformational change. Whether or not the individual entities accept the supply chain strategy and incorporate it into their corporate strategy is of great importance. It is for this reason that misuse of power through forced collaboration is very ineffective. It would simply lead to lots of friction and negative behavior. Successful fulfillment of the desired chain transformation requires co-assistance of all entities and all employees. Hence the supply chain strategy needs to be aligned with all supply chain entities and within all entities, i.e. with the corporate strategy. Again, this is easier said than done, and the main resistance to this often comes from inside the participating entities themselves - that cultural factor again which Gattorna (2006) aptly described as the *forces of darkness.*

Both corporate and supply chain strategies are future-oriented statements. They verbalize the strategy and objectives by taking a holistic view. Kaplan and Norton (2001) discuss how the corporate strategy is aligned with all organizational units, staff functions and business units. Similarly, the supply chain strategy needs to be aligned with all supply chain entities, and at the very least, with collaborative members. SCMR and CSC (2004) reveals that 66% of the survey respondents more or less succeeded to align the supply chain strategy with their corporate strategy (see Figure 4a). In fact, the alignment can be quite complicated since multiple entities must agree on the strategic objectives and be willing to execute this strategy as well. It even gets more complicated when entities are active in multiple supply chains. These entities need to incorporate multiple supply chain strategies into their corporate strategy. Clearly, the supply chain entities will only try to align this supply chain strategy / strategies if they believe in its value and its success.

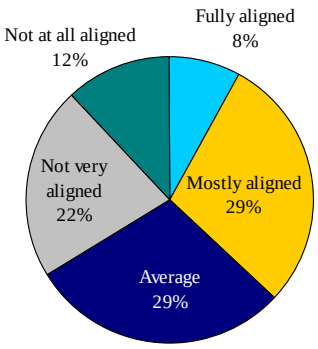


Figure 4a - Alignment of supply chain strategy with corporate strategy (Source: SCMR and SCS, 2004)

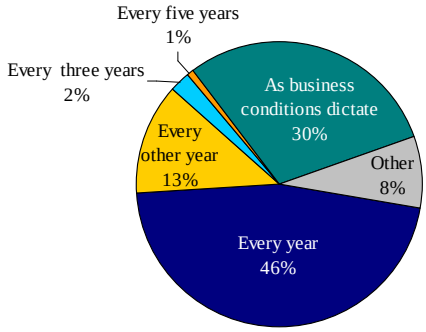


Figure 4b - Frequency of review of supply chain strategy (Source: SCMR and SCS, 2004)

Identifying the most appropriate supply chain strategy

The third action of Kotter is to develop a vision and strategy. The strategic partners should choose the market segments that their supply chain will serve, moreover they should determine their core competencies. This is the point at which they should agree on how they intend to distinguish their products from competitive chains in the chosen market segment (e.g., lowest cost, best customer service, latest technology, sustained reliability). Mason-Jones et al. (2000) argue that the supply chain must excel at the order winner metrics (for instance price or service), and be highly competitive at the order qualifier metrics (for instance quality, lead time).

Fisher (1997) developed a simple framework for matching the right supply chain strategy with the product. He distinguishes between products with predictable demand (i.e. functional products) and unpredictable demand (innovative products). Lee (2002) expands the framework of Fisher to include both demand and supply uncertainty. Also Lee employs explicitly the customer perspective. "The strategy needs to be tailored to meet specific needs of the customers." He emphasizes the notion of uncertainty. "A product with a stable demand and a reliable source of supply should not be managed in the same way as one with a highly unpredictable demand and an unreliable source of supply."

There remain two issues with the simple representation of both Fisher (1997) and Lee (2002). Of course, it is intuitively clear that different supply chains should have different strategies. Lee (2002) warns that one-size-fits-all supply chain strategies are condemned to fail. However, should all entities in one supply chain follow the same strategy? And secondly, does a supply chain not face varying levels of dynamics concerning buying behavior of customers?

Firstly, the consequences of the supply chain strategy are not equal for all supply chain entities. Fisher (1997) and Lee (2002) present supply chain strategies that are "blanket approaches across the whole supply chain". This is not appropriate, Mason-Jones et al. (2000) argue, not all supply chain entities should pursue the same strategy. As such the authors divide the supply chain in two: upstream the Customer Order Decoupling Point (CODP) and downstream the CODP. Upstream should focus on lean processes (i.e. eliminate all waste) and downstream should focus on agile processes (i.e. design for total flexibility). Also Olhager (2003) acknowledges the strategic importance of the CODP and also distinguishes between the upstream and downstream operations;

although he focuses mainly on manufacturing operations. These authors clearly differentiate strategies between the supply chain entities.

Secondly, the fact is overlooked that customers are *not* locked into a single buyer behavior. Gattorna (2006) has indicated that a more realistic is to view the 'alignment' of supply chains with customers as *dynamic* and changeable depending on the situation where customers find themselves in at the time of purchase.

A new framework is presented taking in account the above-mentioned extensions. Figure 5 gives a new representation of the supply chain. Every box symbolizes a supply chain entity, which can be in fact just a part of an organization involved in the SCC. The supply chain entities are roughly grouped into Critical Time Path (CTP) and Supply Path (SP) (also referred as non-CTP). This corresponds to the distinction of "upstream" and "downstream" made by Mason-Jones et al. (2000). Where the CTP is the path from the CODP to the end-customer, exactly this link of dependent processes determines the customer lead-time. The endpoint is the demand-driven point and defines the connectivity of the supply chain. Unique channel strategies are defined for every distinguished type of buying behavior. Note that the type of buying behavior is a combination of product, customer and cluster (i.e. region). The resulting picture looks more like a network, using the critical time paths (downstream) and supply paths (upstream), and provides a more realistic representation of the supply chain.

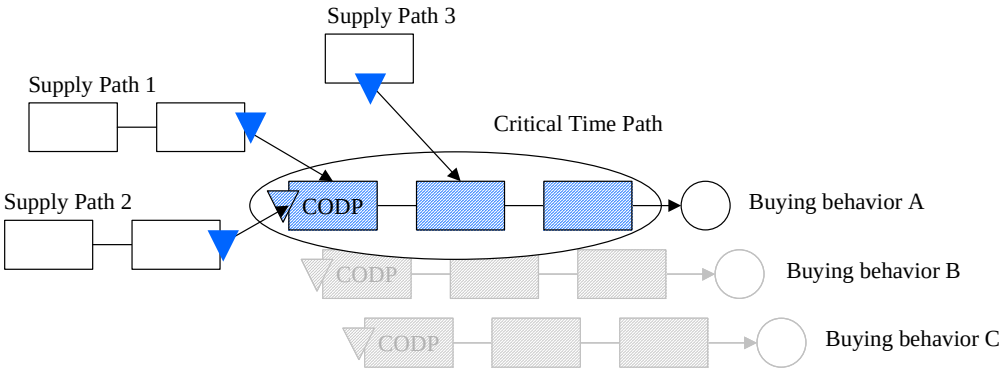


Figure 5 - Safeguarding the customer lead time

In determining the right supply chain strategy and aligning this with each specific supply chain entity, we like to address the product characteristics and customer characteristics. Which was previously known as the "uncertainties framework" will now be presented as the dynamics framework. We distinguish between customer dynamics and supplier dynamics faced by the most critical part of the chain namely the CTP.

The level of customer dynamics is determined by: customer behavior at time of purchase, predictability of demand, product life cycle (length and current stage), and product variety. The level of supplier dynamics is determined by: variability in different manufacturing stages (like breakdowns and quality problems, etc.), reliability of suppliers in term of time and quantity (Delivered In Full On Time), and the level of collaboration in supplier-customer relationship. Since the level of dynamics varies greatly per industry, the CTP will not be equally *"critical"* in every industry and its specific channels (buying behavior types). In the next section we elaborate on the implications of the supply chain strategy.

The strategy loop should be revisited regularly. SCMR and CSC (2004) examined the frequency of review of supply chain strategies (see Figure 4b). However, the strategic partners should not stick to this low-frequent strategy review, but combine the high-frequent performance meetings with discussion of the strategic measures, for instance by means of the Balanced Scorecard. This will make strategy a continual process (Kaplan and Norton, 2001).

4.2 THE CHANGE LOOP

Collaboration is about change, albeit gradual changes as relationships develop. One of the realities we discussed deals with changes and priorities. Identifying what is the right priority or what needs to be changed can be pretty tough in a complex system like a supply chain. In accordance with the forgoing conclusion regarding the strategy alignment, we believe that priorities differ for each supply chain entity, either belonging to CTP or non-CTP. This section discusses how the derived strategic objectives form the basis for transformational changes: which entities need to change, the continuous improvement concepts of TOC, and what to change to.

Which entities must change?
At this stage the collaboration leader, in consultation with the strategic partners, determines which chain entities should be included in the collaboration process. In fact the concept of choosing the collaboration group is rather simple. Every entity performing below target chain performance must be included. Note that the target performance is updated as the SCC accomplished to fulfill the planned change initiatives. Hence, new supply chain entities might be added to the SCC with the introduction of new collaboration initiatives.

We roughly measure the ability of an entity to meet the supply chain performance goals by its performance on lead-time, quality, DIFOT, and costs. The impact of the collaboration in terms of investments may differ greatly per entity. However, there must always be evidence of benefit for each entity, otherwise the collaboration will not be sustainable. Here, the TOC concepts are useful to identify where to change, what is the benefit and ultimately what to change to. Another way is to use the behavioral segmentation proposed by Gattorna (2006) to guide us in designing the internal capabilities of the organization at each buyer-supplier interface. By comparing the external market cultures of customers with the internal cultures of the supply organizations in the chain, the gaps can be measured and used as the basis for a transformation program.

Supply Chain Change and Theory Of Constraints
Rahman (2002) discusses the use of the TOC thinking process in a supply chain environment. With help of current reality trees the supply chain cause-and-effect relationships are structured, which makes the identification of core problems easier. Identifying the core problems is one step of the continuous improvement suggested by TOC. In total five steps are provided to deal with the system's constraints: 1) identify the constraint; 2) exploit the constraint; 3) subordinate everything else to the above decision; 4) elevate the constraint; and 5) repeat these steps.

The first step, identification of the supply chain constraints, is dominated by the perception of the collaboration leader and its strategic partners. Strategic objectives and change priorities are usually decided at the top. And recall that the kind of constraints blocking the supply chain performance can be a physical constraint, market constraint or policy constraint.

The second step deals with exploiting the constraint. TOC suggests that the system cannot perform better than the bottleneck, or the weakest link. The pace of the bottleneck determines the pace of the rest. Finding the source of the bottleneck, which may be one or more supply chain

entities, is not always easy due to the interacting nature of the constraints. For example, when the capacity within an entity is acclaimed to be too low, this can easily be settled by adding capacity. However the real cause might have been due to poor internal co-ordination, or external (replenishment) policies of another entity. Taking a holistic view is essential to find out where exactly a change is required. Tools such as system dynamics and simulation are very useful in this analysis. When the bottlenecks are identified, the collaboration leader decides how the bottlenecks will be exploited and instructs the collaboration coordinator on the details of the coordination.

The third step, subordination of everything else, demands to get the *other collaboration entities* involved as well. The role of the other supply chain entities becomes clear now as all non-bottleneck entities usually found on non-CTP are subordinated to the bottleneck entities. The non-bottleneck entities are adjusted to support the maximum effectiveness of the constraint and as such lead to more effective resource utilization (Rahman, 2002). This may affect the entity's production strategy: make-to-stock, make-to-order, assemble-to-order (Olhager, 2003), buffer management, replenishment, distribution, etc. Note again that the extent of change required depends heavily per entity and its position in the chain. In the future all involved entities have to justify their actions to both the collaboration coordinator and the leader.

The fourth step, elevating the constraint, can get complicated when the constraint is not physical. While a decision like adding capacity through investment or outsourcing is fairly simple, changing policies and the mindset of employees can be a lot tougher. Moreover, executing the fourth step can be troublesome if it concerns high investments. Problems concentrate on "who will pay", while: "it is in your interest as well". If the constraint is successfully removed this will make the bottleneck shift to another place. Therefore, it is sometimes intentionally opted *not* to elevate a constraint if the position of the bottleneck is such that it can easily be managed.

The fifth step, repeating the previous four steps, in fact shows that SCC is a continuous process. As Rahman (2002) puts it: "as the business environment changes, no policy or solution may be appropriate for all time or in every situation". We agree with this position, but nevertheless, as concluded earlier, failure is part of the reality and shows that limits to collaboration occur frequently.

What to change to?

In the strategy loop the collaboration leader and its strategic partners agreed on their supply chain strategy, which states the unique market segments that the supply chain will pursue on and on what basis the supply chain will compete. The implications of the chosen supply chain strategy will differ per supply chain entity (Mason-Jones et al., 2000; Olhager, 2003). In general, upstream can be forecast-driven and aim for more efficiency; while downstream responses to exact customer orders and aims for responsiveness. As such, we introduced a new representation of the supply chain, which consists of the downstream CTP and upstream non-CTPs. The CTP, i.e. the sequence of dependent processes from CODP to the end-customer, determines the customer lead-time. Any direct disruption *within* the CTP and indirect disruption by deliveries *to* the CTP negatively impacts the customer lead-time. This new representation of the supply chain helps to analyze and list the priorities for change and decide what to change to.

When all knowledge on SCM is cut down to the basics, two instruments remain which are used in tuning the supply chain. That is capacities and inventories. Those two are the basic instruments that deal with the respective dynamics in the supply chain, whether this is low or high. Strategically deciding on the use of capacities and inventories allow the integrated supply chain to increase overall performance. These two have great influence on each other, something that is neglected very often. "Hierarchical decision-making processes motivate the separation of capacity and inventory

decisions." Bradley and Arntzen (1999) argue that traditionally capacity and inventory decisions are respectively taken care of by higher-level and lower-level managers. Moreover, they show that simultaneously considering capacity and inventory decisions yield superior financial results. A common misunderstanding is to maximize capacity utilization, which can lead to an inappropriate balance of capacity and inventory. This phenomenon has been observed in the literature on manufacturing, yet is still neglected in supply chain management. For example our experience with a major electronics company shows that while the company paid attention in increasing capacity efficiencies it overlooked the consequence down the stream resulting in huge inventories in other independent business units of the same enterprise.

Thus, balancing the global and local priorities lies within the proper positioning the buffers and set the capacities along the chain. These decisions are considered prime issues in supply chain design or re-design. There are three types of capacities to be set: productive capacity to meet demand, protective capacity to protect against statistical fluctuation of the process, and excess capacity for quickly adapting to customer dynamics. Furthermore, three types of inventories are possible: supply inventories at the connection of the non-CTPs to the CTP, CODP inventory, and distribution inventories are placed before the end-consumer. The ideal configuration ultimately depends on the specific supply chain and its specific dynamics. Table 2 summarize the implications of the supply chain strategy to the supply chain priorities for entities belonging to CTP or non-CTPs. We stress that alignment is repeated for each channel, i.e. customer buying behavior type.

Table 2 - The implications of the supply chain strategy

Customer dynamics	**Supplier dynamics**	**Non-critical paths ("upstream")**	**Critical time path ("downstream")**
Low	Low	▪ Low protective / low excess capacity ▪ Low inventories	▪ Low excess capacity ▪ Low inventories
Low	High	▪ High protective capacity ▪ High supply inventories	▪ High CODP inventory
High	Low	▪ High excess capacity	▪ High excess capacity ▪ High distribution inventories
High	High	▪ High protective capacity ▪ High excess capacity ▪ High supply inventories	▪ High CODP inventory ▪ High excess capacity ▪ High distribution inventories

Quantitative analysis, like optimization and simulation, should provide the evidence for collaboration benefits and detailed information concerning the future of: (1) supply chain design, and (2) supply chain coordination.

Supply chain design addresses the question "how to design a supply chain conforming with the strategic objectives?". Focus point is balancing global and local priorities by determining the locations, number and the size of supply chain entities, where the right capacities and buffers should be positioned.

Supply chain coordination addresses the question "how to coordinate the flows of information, goods and cash in order to realize the strategic objectives?". Focus points are: risk control (where should uncertainty of supply or demand be reduced first?); production policies (e.g. outsourcing

decisions, scheduling, planning); replenishment policies (e.g. inventory management); distribution policies (e.g. outsourcing decisions, planning, routing). The reader is referred to Wong et al. (2004) for an extended literature overview on supply chain coordination problems.

The change loop brings the supply chain strategy to concrete supply chain change initiatives and execution. The TOC concepts help to identify where change is required first. Further quantitative analysis should detail the decisions regarding the supply chain design and supply chain coordination. The change loop is an ongoing process, step-by-step bringing the supply chain performance to a higher level.

4.3 THE CONTROL LOOP

The loops are closed by the control loop. Major part of control is about performance measurement. Performance measures enable management to make the right analysis and ultimately the right decisions. This governance process, allows the collaboration decisions from strategic to tactical and operational be examined continuously. It can do no harm to stress that, hence, performance measures must be constructed on those three levels (Gunasekaran et al., 2001; Kaplan and Norton, 2001). We list three functionalities of the control loop: 1) to continuously check on current performance against the targeted outcomes, 2) to test and reveal the viability of the supply chain strategy (Gunasekaran et al., 2001), and 3) to allocate benefits and burdens resulting from functional shifts in the supply chain (Lambert and Pohlen, 2001).

The first function is to govern the transformational changes. One could say this concerns tactical and operational management. Performance measurement exercises a continual focus on the change initiatives and current performance against targeted outcomes. An important component in supply chain design and analysis is the establishment of appropriate performance measures (Beamon, 1998). The holistic perspective of the SCC initiatives needs to be captured in the performance measures as well. Together with the change initiatives the involved supply chain entities are informed of the new supply chain performance measures. As soon as the changes are implemented the entities are inquired to measure accordingly and report these to the supply chain coordinator. Ultimately at the top the leader regulates the whole process.

The second function is to govern the strategic objectives. Measures are needed to test and reveal the viability of the supply chain strategy, without which a clear distinction for improvement and realization of goals would be highly difficult (Gunasekaran et al., 2001). Also Kaplan and Norton (2001) and Lee (2003) point out that the strategy and vision of a company should be a closed loop and continuous process. As Lee phrases it: “today’s order winners are tomorrow’s order qualifiers”. Lee (2003) tells us that companies, or supply chains, survive by being able to manage transitions, e.g. changing market conditions, evolving technology, different requirements as a product moves through its life cycle. “The ones that can adapt will be here for a long time.” In other words, business dynamics push companies and chains to change continuously.

The third function, which is not discussed in this paper at all, is to allocate benefits and burdens. Especially when the supply chain enters an intensive form of collaboration, sharing investments and profits is a logical consequence of bringing the chain to an even higher standard. Performance measures are required in order to allocate the investments or profits properly among the involved chain entities.

Establishing the appropriate supply chain metrics is a matter of great importance. Wrong metrics may lead to contradictory decision-making (Kaplan and Norton, 2001). Moreover, some measures can be sufficient locally, but are meaningless on the supply chain level. Lambert and Pohlen (2001) give such an example on the inventory turnover. In short, key performance indicators (KPIs) are vital in shaping the alignment between parties in the supply chain, but they are only one factor- there are several other as described by Gattorna (2006), and the combinations of these all vary according to the type of supply chains in play.

The collaboration leader and its strategic supply chain partners take care of determining the appropriate metrics, which will be specifically tailored to the strategic objectives of the collaboration initiatives. For comprehensive lists of suitable supply chain metrics the reader is referred to Kaplan and Norton (1996), Beamon (1998), Lambert and Pohlen (2001), Gunasekaran et al. (2001), and Taguchi et al. (2005).

The role of information technology is shifting from a passive management enabler through databases to a highly advanced process controller that can monitor each activity (Gunasekaran et al., 2001). However, what nowadays is called "Business Intelligence" often only proves the corporation's ability to gather data. Tons of data is tracked and stored. Of course, the edge is gained in using the right data and knowing how to filter the data.

Goldratt (1990) warned for this development already two decades ago. "Even if we are lead to believe that everything is important, we still remember that some things are more important than others – the Pareto Principle." Goldratt argues that most understand the Pareto principle as the 20/80 rule. Twenty percent of the variables are responsible for eighty percent of the result. He acknowledges this 20/80 is right for independent variables; for dependent variables, however, 0.1/99.9 will be a better approximation. Similarly, Kaplan and Norton (1996) argue that the selection of performance measures needs to be reduced heavily. Hundred performance measures will only deceive the managers from the overall business developments. Good control starts with finding the few key performance measures.

4.4 CLIMBING THE LADDER OF COLLABORATION

The loops of collaboration emphasize the stepwise improvement of the supply chain performance through collaboration. We call this process "the ladder of collaboration", which is a symbolic growth path for the SCC. The difference between the current level of supply chain performance and the target level needs to be covered by the collaboration initiatives. We believe that for climbing successfully there are only few focus points. Or as TOC explains: "there are only few system constraints at a time". The entities that currently underperform are of primary concern. Adopting the TOC approach shows where and how to bring about the transformational changes. Step-by-step the supply chain performance is boosted.

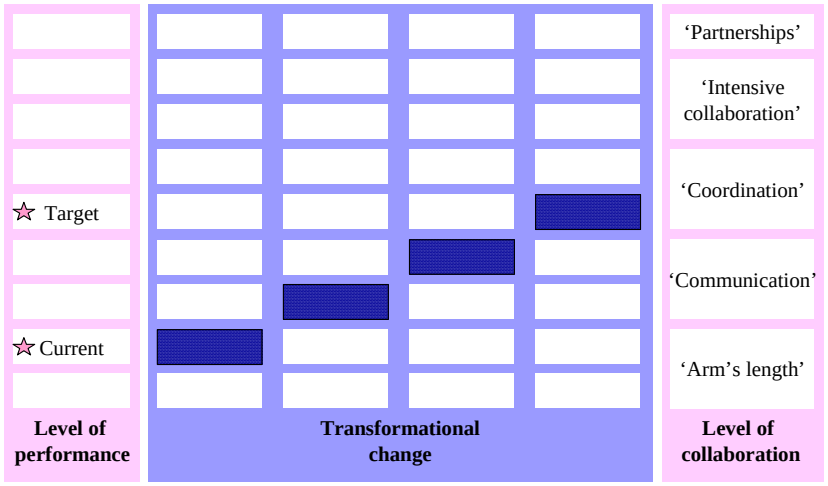


Figure 6 - The ladder of collaboration

With each level of supply chain collaboration, performance (sub)targets are associated. Only if all involved collaboration members succeed to attain the (sub)target, it is possible to move on to the next level. Besides a necessary level of performance, certain prerequisites such as the IT infrastructure, physical infrastructure, etc must be in place at the collaboration members. As such the collaboration path is roughly divided into several levels of collaboration (see Figure 6). Below we address these levels:

The initial level of collaboration is *‘Communication’* assuming there is no collaboration at first. The goal of this level is to improve productivity and enable information sharing or forecasts through simple IT systems. Communication is productivity-centric allowing the collaboration members to enhance decision-making and may result in improved delivery rates, fewer inventories, etc. The focus is on dealing with physical supply chain constraints.

Second level of collaboration is *‘Coordination’*, which focuses on the coordination of intra and inter-entity processes. The main purpose at this level is to synchronize flows and also automate certain routine decision making processes to improve the speed and accuracy. Tools are strategic positioning and sizing of capacities and buffers, and development of simple decision-making tools. The focus is on dealing with both physical and policy constraints. ‘Coordination’ requires the necessary additional investments in IT infrastructure and planning modules.

Third level of collaboration is *‘Intensive collaboration’*, which implies increased involvement of the collaboration members to improve the strategic management decision-making and enhance innovation in the chain. The high level of collaboration creates a more open dialogue environment, both within and amongst collaboration entities. Collaboration tends to spread to other areas of the enterprise than just related to logistics flows. The focus is on further dealing with policy constraints.

Fourth level of collaboration is *‘Partnerships’*, which involves extended financial linkages, such as sharing of investments and profits. The aim is to drastically improve knowledge sharing between members and reduce R&D time, ensure that through right joint investment new capabilities are added to address the new market needs (and remove any market constraints).

5. CONCLUSIONS

The reality is that many SCC initiatives fail. Still, the world believes in the value of selective collaboration. It's our job to improve the ratio of supply chains that achieve higher performance through successful collaboration. Therefore we started this paper by carefully addressing some misunderstandings and myths about the collaboration process.

First, collaboration comes in many formats. The structure of the collaboration especially depends on the business roles of involved supply chain entities, i.e. the powerhouses in the chain. We cannot approach every relationship similarly by stating that equal partnership is a necessity. That is not what the reality gives us.

Second, the collaboration group sometimes faces a supply chain constraint that puts a hold to further collaboration. Whether this is a resource, market or policy constraint, remember that the structure of the collaboration group significantly impacts the types of constraints it can deal with.

Third, collaboration ends up in failure when the start is all wrong. Too often there are compromises dictate the collaboration process turning it into a negotiation. The result is a mixed-up balance between global effectiveness and local efficiencies. On the whole, the collaboration can only go down and that's exactly what will happen.

Given these realities we described prerequisites of the collaboration process in the form of loops. Loops are characterized by repetition. That is what happens in SCC as well. The three sets of decision-making concerning strategy alignment, supply chain change and control, highly interact with each other and make the collaboration a continuous process.

A conclusion one can surely draw is that the SCC process itself is a journey not a result. Therefore, the five steps of Theory of Constraints can help structuring this journey for us. More research work has to be conducted in quantifying the cost and benefits of collaboration in supply chains, and how collaboration works through the types of cultural enablers and inhibitors described by Barratt (2002). Some work like risk pooling measurement, value of information sharing, etc., have been already been done. The framework presented here can help in identifying some of the underlying mechanisms at work in supply chain collaboration, and to point the way for further study of the financial implications of good and bad collaboration.

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